UNITED STATES PATENT AND TRADEMARK OFFICE

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ADVANCED MICRO DEVICES, INC.
C/O VEDDER PRICE P.C.
222 N.LASALLE STREET
CHICAGO, IL 60601

EXAMINER
NGUYEN, PHILLIP H

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 February 2008*.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO/SB/08)
    Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application

6)☐ Other: _____ .

DETAILED ACTION

1.   This action is in response to the amendment filed 2/12/2008.

Response to Amendment

2.   Per applicant's request, claims 1, 10, and 19 have been amended; claims 1-21 remain pending and have been considered below.

Response to Arguments

3.   Applicant's arguments filed 2/12/2008 have been fully considered but they are not deemed persuasive.

Applicant asserts on page 9 of the amendment regarding claims 1 and 10 that Ng fails to describe or suggest **redundancy checking** *for superword register or multiple components contained in a superword register.*

Examiner respectfully disagrees with the allegation as argued. Ng's invention is directed toward code redundancy removal using extended global value numbering (see at least FIG. 3; see also col. 6:66-67 – col.7:1-2).

Applicant asserts on page 9 of the amendment regarding claims 1 and 10 that Ng fails to describe or suggest **retrieving an operation value number** *from a first hash table based on the first hash value wherein said operation value number corresponds to components contained by superword register.*

Examiner respectfully disagrees with the allegation as argued. Ng teaches "A Hash table is used to speed up the storing and **retrieval of value numbers**" (see col.

7:51-52). Ng further teaches "The Value Number List of an incoming expression is computed and compared with the Value Number List of a current expression. If the two VNlists match in value, and in order, then the expression is redundant..." (see at least col. 7:6-9). In other words, value numbers are retrieved from the Hash table for comparing to identify expressions that are candidates for redundancy removal. Applicant is suggested to see other sections for further explanation of retrieval of value numbers.

Applicant asserts on pages 9-10 of the amendment regarding claims 1, 10, and 19 that Ng fails to describe or suggest *generating a results value number based on previous value number and the operation value number wherein the said result value number is a combination of operation value numbers*. Applicant further states that Ng defines a "value number" as "a symbolic execution of a basic block of code, in which all variables entering that basic block of code (straight line code) are given distinct symbolic values or value numbers." (col. 5:37-41). Therefore an "operation value number corresponds to components contained by a superword register and "a result value number is a combination of operation value numbers," both in accordance with claim 1, are patentably distinguishable from the "value numbers" described by Ng.

Examiner respectfully disagrees with all the allegations as argued. First, Ng states that "A value number in **the prior art** is a symbolic execution of a basic block of code, in which all variables entering that basic block of code (straight line code) are given distinct symbolic values or value numbers." In other words, Ng recognizes the differences between the prior art and his invention. In addition, even if the Ng defines

his value number as a symbolic execution of a basic block of code, it is still a value number assigned to an expression (i.e. instruction). The claim language does not limited to any type of value number. Second, Ng further teaches "Each time a new value number is formed, the expression is entered into the hash table. Value numbers and value number lists are evaluated and created using the following rules...If the value numbers are not equal, then a new value number is formed and assigned if not already assigned" (see at least col. 8:7-28). In other words, a result value number is generated if the incoming value number compared against the current value numbers from Hash table is not matched.

Applicant asserts on page 10 of the amendment regarding claims 1 and 10 that Ng fails to describe or suggest *determining if the instruction is* **redundant** *by search a second hash table using the result value number*.

Examiner respectfully disagrees with the allegation as argued. Again, Ng teaches "**A hash table**, illustrated in FIG. 6 and described below in the section entitled "**Hash Table**", is used for fast access in Extended Global Value Numbering**. This hash table reduces the **search time** and space needed later for **redundancy removal**. This **hash table also enables the searches to be done** with "context" and in a predictive manner, as opposed to conventional methods in which all expressions were attempted to be moved upwards" (see col. 5:57-64). Ng further teaches "A **Hash table** is used to speed up the **storing and retrieval of value numbers**. The hash key consists of the op-code plus all its operands" (see at least col. 7:51-52). In other words,

Ng's approach uses hash table for performing value numbering to identify expressions

(i.e. instructions) that are candidates for redundancy removal.

Applicant asserts on page 11 of the amendment regarding claims 6, 15, and 20

that Ng fails to teach *when the first hash value is not within the first hash table,*

*assigning (assigns) the first hash value **a multiple component hash value**.*

Examiner respectfully disagrees with the allegation as argued. Applicant's

specification discloses "the value numbers of all inputs (i.e. operands) to generates a

first hash value" (see paragraph 20). In other words, applicant states that the value

numbers are the operand value numbers. By definition, an instruction (i.e. expression)

consists of two or more type of components (operands and operators). Now, Ng

teaches "the value numbers are the numbers assigned to the expressions (see at last

col. 5:53).

Examiner is entitled to give claim limitations their broadest reasonable

interpretation in light of the specification. See MPEP 2111 [R-1] Interpretation of

Claims-Broadest Reasonable Interpretation.

During patent examination, the pending claims must be given their broadest

reasonable interpretation consistent with the specification. Applicant always has the

opportunity to amend the claim during the prosecution and broad interpretation by the

examiner reduces the possibility that the claims, once issued, will be interpreted more

broadly than is justified. In re Prater, 162 USPQ 541, 550-51 (CCPA 1969).

Allowable Subject Matter

4.   Claims 8, 16, and 21 are objected to as being dependent upon a rejected base

claim, but would be allowable if rewritten in independent form including all of the

limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 112

5.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly
> claiming the subject matter which the applicant regards as his invention.

6.   Claims 1 and 8 recite the limitation "the instruction" in the body of the claims

There is insufficient antecedent basis for this limitation in the claim. Claims 2-9 directly

or indirectly depend on claim 1 and therefore suffer the same deficiency.

Claim Rejections - 35 USC § 102

7.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public
> use or on sale in this country, more than one year prior to the date of application for patent in the United
> States.

8.   Claims 1-7, 9-15, and 17-20 are rejected under 35 U.S.C. 102(b) as being

anticipated by Ng (USPN 6,035,124).

As per claims 1 and 10:

        Ng teaches:

hashing an operation code and corresponding value numbers to generate

a first hash value (see at least col. 6, lines 13-14 "hashing for x2+y0 obtains two

different values for x0+y0 and x1+y0, respectively" also see at least "**TABLE A**"

for more details);

retrieving an operation value number from a first hash table based on the

first hash value wherein said operation value number corresponds to

components contained by a superword register (see at least col. 7:51-52 "A Hash

table is used to speed up the storing and **retrieval of value numbers**"; see also

col. 7:6-9 "The Value Number List of an incoming expression is computed and

compared with the Value Number List of a current expression. If the two VNlists

match in value, and in order, then the expression is redundant...");

generating a result value number based on a previous bit hash value and

the operation value number wherein said result value number is a combination of

operation value numbers (see at least col. 8:7-28 "Each time a new value

number is formed, the expression is entered into the hash table. Value numbers

and value number lists are evaluated and created using the following rules...If the

value numbers are not equal, then a new value number is formed and assigned if

not already assigned"); and

determining if the instruction is redundant by searching a second hash

table using the result value number (see at least col 5:57-64 "**A hash table**,

illustrated in FIG. 6 and described below in the section entitled "**Hash Table**", **is**

used for fast access in Extended Global Value Numbering. This hash table

reduces the **search time** and space needed later for **redundancy removal**.

This **hash table also enables the searches to be done** with "context" and in a

predictive manner, as opposed to conventional methods in which all expressions

were attempted to be moved upwards"; see also col. 7:51-52 "A **Hash table** is

used to speed up the **storing and retrieval of value numbers**. The hash key

consists of the op-code plus all its operands" - In other words, Ng's approach

uses hash table for performing value numbering to identify expressions (i.e.

instructions) that are candidates for redundancy removal).

As per claims 2 and 11:

Ng further teaches:

when the result value number is found within the second hash table,

retrieving an output of the instruction from the second hash table (see at least

col. 9:36-38 "if a value number has been assigned to the LHS (left hand side),

then processing continues to decision block 525 to determine if any right hand

side (RHS) operands of the current expression have an unknown value number"

– In other words, if a value number is found, a determination of RHS operands is

performed, and in order to perform the determination, the value number of the

operands must retrieve from the hash table to compare).

As per claims 3 and 12:

Ng further teaches:

when the result value number is not found within the second hash table,

writing the result value number to the second hash table (see at least col. 9:22-

24 "if no value number has been assigned to the LHS (left hand side), then

process block 520 creates and assigns a new unique value number to the LHS").

As per claims 4 and 13:

Ng further teaches:

prior to generating a result value number, retrieving the previous value

number (see at least col. 8:27-28; it is inherent in Ng's method. In order to

generate a new value number, previous bit hash value must retrieve to perform

the comparison*)*.

As per claims 5 and 14:

Ng further teaches:

prior to retrieving the operation value number, comparing the first hash

value with a first hash table (see at least col. 8:27-28; it is inherent in Ng's

method. In order to generate a new value number, a comparison between the

hash value numbers with the hash table must perform to find out if it is

redundant).

As per claims 6, 15 and 20:

Ng further teaches:

when the first hash value is not within the first hash table, assigning the

first hash value a multiple component hash value (see at least col. 8:27-28 "if

value numbers not equal, then a new value number is formed and assigned if not

already assigned").

As per claim 7:

Ng further teaches:

wherein the operation value number is an n-tuple number (see at least col.

6:3 "xi (i.e., x0, x1, x2,...)"; see also at least col. 6:51-54 "All expressions that

look lexically the same (e.g., x0+y0, x1+y1, x2+y2) together with all other

expressions sharing the same value numbers with these lexically similar

expressions").

As per claim9:

Ng further teaches:

wherein the instruction further including a previous bit and a write mask

(see for example, FIG. 6, and texts for further expanding its features; see also at

least col. 9:20-67 "Hash Table").

As per claim 17:

Ng further teaches:

a superword register operably coupled to the processor, the superword

register operative to store a plurality of instructions therein (see at least FIG. 10).

As per claim 18:

Ng further teaches:

at least one hash memory device operably coupled to the at least one

processor such that the at least one hash memory device is operative to store

the first hash table and the second hash table (see at least FIG. 10).

As per claim 19:

Ng further teaches:

hashing an operation code and corresponding value numbers to generate

a first hash value (see at least col. 6:13-14 "hashing for x2+y0 obtains two

different values for x0+y0 and x1+y0, respectively"; also see "TABLE A" for more

details);

comparing the first hash value with a first hash table (see at least col.

8:27-28; it is inherent in Ng's method. In order to generate a new value number,

a comparison between the hash value number with the hash table must perform

to find out if it is redundant);

retrieving an operation value number from the first hash table (see at least

col. 7:51-52 "A hash table is used to speed up the storing and retrieval of value

numbers"; also see at least col. 8:27-28 "if value numbers are not equal, then a

new value number is formed and assigned if not already assigned" – In other

words, retrieving the value number from the hash table must performed in order

to compare the value numbers);

retrieving a previous value number (see at least col. 8:27-28; it is inherent

in Ng's method. In order to generate a new value number, previous bit (can be

previous value number or opcode or any operand value) hash value must

retrieve to perform the comparison);

generating a result value number based on the previous value number

and the operation value number wherein the said result value number is a

combination of operation value numbers (see at least col. 8:7-28 "Each time a

new value number is formed, the expression is entered into the hash table.

Value numbers and value number lists are evaluated and created using the

following rules...If the value numbers are not equal, then a new value number is

formed and assigned if not already assigned");

searching a second hash table using the result value number (see at least

col. 10:26 "redundancy may be determined by a lookup each time any code is

moved");

if the result value number is found within the second hash table, retrieving

an output of an instruction from the second hash table (see at least col. 9:36-38

"if a value number has been assigned to the LHS (left hand side), then

processing continues to decision block 525 to determine if any right hand side

(RHS) operands of the current expression have an unknown value number" – In

other words, if a value number is found, a determination of RHS operands is

performed, and in order to perform the determination, the value number of the

operands must retrieve from the hash table to compare); and

if the result value number is not found within the second hash table,

writing the result value number to the second hash table (see at least col. 9:22-

24 "if no value number has been assigned to the LHS (left hand side), then

process block 520 creates and assigns a new unique value number to the LHS").

Conclusion

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Phillip H. Nguyen whose telephone number is (571)

270-1070. The examiner can normally be reached on Monday - Thursday 10:00 AM -

3:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Wei Y. Zhen can be reached on (571) 272-3708. The fax phone number for

the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

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For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

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system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PN
4/23/2008

/Wei Zhen/
Supervisory Patent Examiner, Art Unit 2191